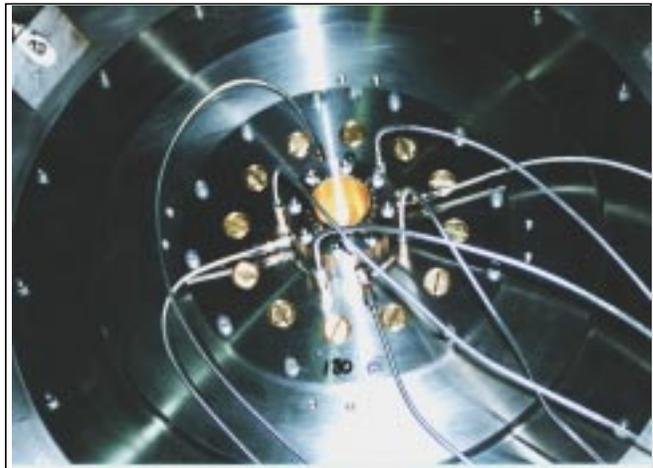


September 1996 Highlights of the Pulsed Power Inertial Confinement Fusion Program

A new Technical Contract to replace the 3 November 1995 one describes the four components of our program: x-ray source development, high yield target physics, ion beam generation and transport, and the National Ignition Facility. All PBFA-Z power flow hardware has now been received, installed, and tested using short circuit loads, and we are preparing for the first radiation shot.



Low inductance short-circuit load on PBFA Z that delivered 4.2 MA at 60-kV electrical charge (1/2 power operation). The eight cables connect dB/dt load current monitors.

Comparison of data from low and high inductance short-circuit load shots on PBFA Z (see figure) at 60, 74, and 85 kV indicates excellent agreement with the current amplitude and wave shape predicted by the lumped-element circuit code SCREAMER. The 85-kV shots represent 1/4 of PBFA Z at the nominal operating voltage. Current and voltage were measured in the nine water transmission lines and at the insulator stack. Local current density was measured in the magnetically insulated transmission lines (MITLs) at four radial and multiple azimuthal locations. The first z-pinch-driven x-ray radiation source shot, with a 4-cm-diameter, 2-cm-long tungsten wire array load (at 74-kV electrical charge with all 36 accelerator modules), is scheduled for the first week in October. Our first major goal is to demonstrate the predicted scaling of x-ray output energy to 1.5 MJ (compared to 0.5 MJ on Saturn) at full electrical charge (85 kV). Before this scaling can be shown, however, we will stress the MITLs and vacuum insulator stack using successively higher voltage wire array loads.

The damaging ion mode instability has been observed on the radially-focusing PBFA-II diode via modulations in the ion current density. Results from the 3-D, electromagnetic, particle-in-cell code QUICKSILVER have shown that this instability in a magnetically insulated ion diode not only increases ion beam divergence, but also enhances electron loss to the anode. These electrons, impinging on the anode surface at a glancing angle because of the strong magnetic field, increase the surface temperature and near-surface charge deposition and thus contribute to nonuniform desorption of surface contaminants. Recently, we have inferred, by analytic extrapolation of the electron energy distribution from the Integrated TIGER Series of coupled electron/photon Monte Carlo transport codes (ITS), that multiple generations of backscattered electrons near the anode can increase the rate of ionization of neutrals by an order of magnitude compared to primary electrons alone. This suggests that avoiding onset of the ion mode instability could also prevent or delay the increase in the non-lithium ion current, which is sometimes referred to as the “parasitic load.”

Sandia has primary responsibility for the power conditioning system that will fire the main amplifier flash lamps in the National Ignition Facility (NIF). The first full voltage shot was fired on the prototype power conditioning module for the NIF. The charge voltage on the 5.8 mF capacitor bank was 23.5 kV, and the required 500-kA, 360-microsecond, critically-damped current pulse was delivered to a 25-milliohm resistive load. (The conceptual design for the NIF includes 216 of these capacitor banks.) The prototype bank consists of 20, parallel-connected, 290-microFarad metallized film capacitors. The commercial switch currently being tested is a Physics International ST-300 spark gap. All module components performed as expected during a ten-shot series in which the charge voltage on successive shots was ramped up from 5 to 23.5 kV. The performance of the power conditioning module will now be characterized in 1000 shots at full charge voltage.

Contact: Jeff Quintenz, Inertial Confinement Fusion Program, Dept. 9502, 505-845-7245, fax: 505-845-7464, email: jpquint@sandia.gov
Highlights are prepared by Mary Ann Sweeney, Dept. 9541, 505-845-7307, fax: 505-845-7890, email: masween@sandia.gov.
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